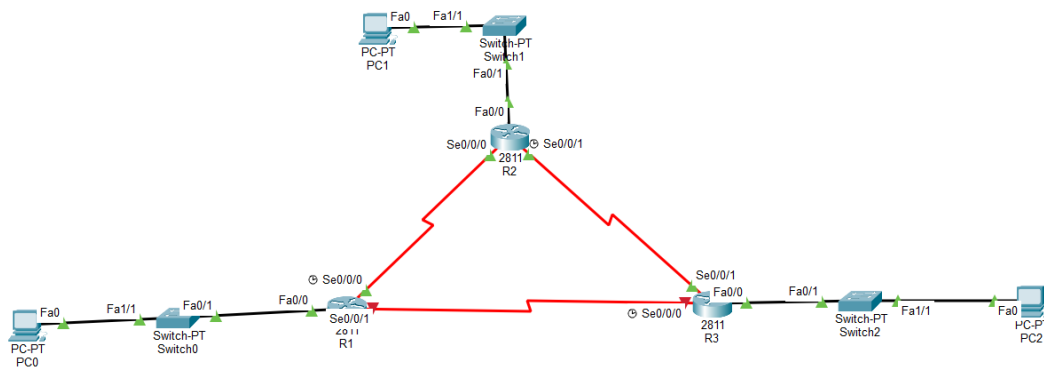


Lab03 : OSPF Configuration

1. Thiết kế lại mô hình mạng theo hướng dẫn bài Lab03 và ghi các bước tiến hành (dòng lệnh thực hiện và chụp màn hình kết quả hoạt động của mạng). Giải thích ý nghĩa từng dòng lệnh

Tôplogy:



Cấu hình Router R1

```
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#interface fa0/0
R1(config-if)#ip address 172.16.1.17 255.255.255.240
R1(config-if)#no shutdown
R1(config-if)#interface s0/0/0
R1(config-if)#exit
R1(config)#interface s0/0/0
R1(config-if)#ip address 192.168.10.1 255.255.255.252
R1(config-if)#clock rate 64000
R1(config-if)#no shutdown
R1(config-if)#exit
R1(config)#interface s0/0/1
R1(config-if)#ip address 192.168.10.5 255.255.255.252
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/0/1, changed state to down
R1(config-if)#exit
R1(config)#
```

Cấu hình Router R2

```
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface fa0/0
R2(config-if)#ip address 10.10.10.1 255.255.255.0
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#interface s0/0/0
R2(config-if)#ip address 192.168.10.2 255.255.255.252
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#interface s0/0/1
R2(config-if)#ip address 192.168.10.9 255.255.255.252
R2(config-if)#clock rate 128000
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#
```

Cấu hình Router R3

```
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#interface fa0/0
R3(config-if)#ip address 172.16.1.33 255.255.255.248
R3(config-if)#no shutdown
R3(config-if)#interface s0/0/1
R3(config-if)#ip address 192.168.10.10 255.255.255.252
R3(config-if)#no shutdown
R3(config-if)#interface s0/0/0
R3(config-if)#ip address 192.168.10.6 255.255.255.252
R3(config-if)#clock rate 256000
Unknown clock rate
R3(config-if)#clock rate 25600
Unknown clock rate
R3(config-if)#clock rate 64000
R3(config-if)#clock rate ?
Speed (bits per second)
 1200
 2400
 4800
 9600
19200
38400
56000
64000
72000
125000
128000
148000
250000
500000
800000
1000000
1300000
2000000
```

```
R3(config-if)#clock rate 64000
R3(config-if)#clock rate ?
Speed (bits per second
 1200
 2400
 4800
 9600
19200
38400
56000
64000
72000
125000
128000
148000
250000
500000
800000
1000000
1300000
2000000
4000000
<300-4000000> Choose clockrate from list above
R3(config-if)#clock rate 250000
R3(config-if)#no shutdown

R3(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

R3(config-if)#exit
R3(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

R3(config)#
```

Cấu hình PC1:

PC0

Physical Config Desktop Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 172.16.1.20

Subnet Mask 255.255.255.240

Default Gateway 172.16.1.17

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::2D0:97FF:FE21:5E6B

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

Password

Cấu hình PC2:

PC1

Physical Config **Desktop** Programming Attributes

IP Configuration X

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 10.10.10.10

Subnet Mask 255.255.255.0

Default Gateway 10.10.10.1

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::209:7CFF:FE3D:DA39

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

Authentication MD5

Username

Password

☐ Top

Cấu hình PC3:

The screenshot shows a window titled "PC2" with tabs for Physical, Config, Desktop, Programming, and Attributes. The "Config" tab is active, and the "IP Configuration" section is expanded. The "Interface" dropdown is set to "FastEthernet0".

IP Configuration

Interface: FastEthernet0

☐ DHCP ☒ Static

IPv4 Address: 172.16.1.35

Subnet Mask: 255.255.255.248

Default Gateway: 172.16.1.33

DNS Server: 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address: /

Link Local Address: FE80::200:CFF:FE1B:7086

Default Gateway:

DNS Server:

802.1X

☐ Use 802.1X Security

Authentication: MD5

Username:

Password:

☐ Top

Cấu hình định tuyến

```
R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#ip route 10.10.10.0 255.255.255.0 192.168.10.2
R1(config)#ip route 172.16.1.32 255.255.255.248 192.168.10.6
R1(config)#
```

```
R2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#ip route 172.16.1.16 255.255.255.240 192.168.10.1
R2(config)#ip route 172.16.1.32 255.255.255.248 192.168.10.10
R2(config)#
```

```
R3#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R3(config)#ip route 172.16.1.16 255.255.255.240 192.168.10.5
R3(config)#ip route 10.10.10.0 255.255.255.0 192.168.10.9
R3(config)#
```

Disable DNS lookup

```
R1(config)#no ip domain-lookup

R2(config)#no ip domain-lookup

R3(config)#no ip domain-lookup
```

Task: Configure OSPF on the R1 Router

```
R1(config)#router ospf 1
R1(config-router)#network 172.16.1.16 0.0.0.15 area 0
R1(config-router)#network 192.168.10.0 0.0.0.3 area 0
R1(config-router)#network 192.168.10.4 0.0.0.3 area 0
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#
```

Task: Configure OSPF on the R2 and R3 Routers

```
R2(config)#router ospf 1
R2(config-router)#network 10.10.10.0 0.0.0.255 area 0
R2(config-router)#network 192.168.10.0 0.0.0.3 area 0
R2(config-router)#
R2(config-router)#
07:04:10: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.5 on Serial0/0/0 from LOADING to FULL,
Loading Done

R2(config-router)#network 192.168.10.8 0.0.0.3 area 0
R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#

R3(config)#router ospf 1
R3(config-router)#network 172.16.1.32 0.0.0.7 area 0
R3(config-router)#network 192.168.10.4 0.0.0.3 area 0
R3(config-router)#
07:05:54: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.5 on Serial0/0/0 from LOADING to FULL,
Loading Done

R3(config-router)#network 192.168.10.8 0.0.0.3 area 0
R3(config-router)#
07:06:19: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/1 from LOADING to FULL,
Loading Done

R3(config-router)#
```

Task: Configure OSPF Router IDs

```
R3#show ip protocols
```

```
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.10.10
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    172.16.1.32 0.0.0.7 area 0
    192.168.10.4 0.0.0.3 area 0
    192.168.10.8 0.0.0.3 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.10.5          110          00:02:14
    192.168.10.9          110          00:01:49
    192.168.10.10         110          00:01:49
  Distance: (default is 110)
```

```
R3#show ip ospf
Routing Process "ospf 1" with ID 192.168.10.10
  Supports only single TOS(TOS0) routes
  Supports opaque LSA
  SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
  Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
  Number of external LSA 0. Checksum Sum 0x000000
  Number of opaque AS LSA 0. Checksum Sum 0x000000
  Number of DCbitless external and opaque AS LSA 0
  Number of DoNotAge external and opaque AS LSA 0
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  External flood list length 0
    Area BACKBONE(0)
      Number of interfaces in this area is 3
      Area has no authentication
      SPF algorithm executed 4 times
      Area ranges are
      Number of LSA 3. Checksum Sum 0x01e247
      Number of opaque link LSA 0. Checksum Sum 0x000000
      Number of DCbitless LSA 0
      Number of indication LSA 0
      Number of DoNotAge LSA 0
      Flood list length 0
--More--
```

```
R3#show ip ospf interface
```

```
FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.33/29, Area 0
  Process ID 1, Router ID 192.168.10.10, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.10.10, Interface address 172.16.1.33
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:08
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial10/0/0 is up, line protocol is up
  Internet address is 192.168.10.6/30, Area 0
  Process ID 1, Router ID 192.168.10.10, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:01
  Index 2/2, flood queue length 0
--More--
```

Use loopback addresses to change the router IDs of the routers in the topology.

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface loopback 0

R1(config-if)#
%LINK-3-UPDOWN: Interface Loopback0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

R1(config-if)#ip address 10.1.1.1 255.255.255.255
R1(config-if)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
~*~

R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface loopback 0

R2(config-if)#
%LINK-3-UPDOWN: Interface Loopback0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

R2(config-if)#ip address 10.2.2.2 255.255.255.255
R2(config-if)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
```

```

R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#interface loopback 0

R3(config-if)#
%LINK-3-UPDOWN: Interface Loopback0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up

R3(config-if)#ip address 10.3.3.3 255.255.255.255
R3(config-if)#end
R3#
%SYS-5-CONFIG_I: Configured from console by console

```

Reload the routers to force the new Router IDs to be used.

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.10.9	0	FULL/ -	00:00:30	192.168.10.2	Serial0/0/0
192.168.10.10	0	FULL/ -	00:00:36	192.168.10.6	Serial0/0/1

R1#

```
R2#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.10.5	0	FULL/ -	00:00:39	192.168.10.1	Serial0/0/0
192.168.10.10	0	FULL/ -	00:00:36	192.168.10.10	Serial0/0/1

R2#

```
R3#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.10.5	0	FULL/ -	00:00:34	192.168.10.5	Serial0/0/0
192.168.10.9	0	FULL/ -	00:00:39	192.168.10.9	Serial0/0/1

R3#

Use the router-id command to change the router ID on the R1 router.

```

R1(config)#router ospf 1
R1(config-router)#router-id 10.4.4.4
R1(config-router)#Reload or use "clear ip ospf process" command, for this to take effect

R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#clear ip ospf process
Reset ALL OSPF processes? [no]: y

R1#
07:17:53: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/0 from FULL to DOWN, Neighbor
Down: Adjacency forced to reset

07:17:53: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/0 from FULL to DOWN, Neighbor
Down: Interface down or detached

07:17:53: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.10 on Serial0/0/1 from FULL to DOWN, Neighbor
Down: Adjacency forced to reset

07:17:53: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.10 on Serial0/0/1 from FULL to DOWN, Neighbor
Down: Interface down or detached

R1#
07:17:58: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/0 from LOADING to FULL,
Loading Done

07:18:05: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.10 on Serial0/0/1 from LOADING to FULL,
Loading Done

```

Use the show ip ospf neighbor command on router R2 to verify that the router ID of R1 has been changed.

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.10.9	0	FULL/ -	00:00:32	192.168.10.2	Serial0/0/0
192.168.10.10	0	FULL/ -	00:00:39	192.168.10.6	Serial0/0/1

```
R1#
```

Remove the configured router ID with the no form of the router-id command.

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.10.9	0	FULL/ -	00:00:32	192.168.10.2	Serial0/0/0
192.168.10.10	0	FULL/ -	00:00:39	192.168.10.6	Serial0/0/1

```

R1#conf t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#router ospf 1
R1(config-router)#router-id 10.4.4.4
R1(config-router)#

```

Restart the OSPF process using the clear ip ospf process command.

```

R1#clear ip ospf process
Reset ALL OSPF processes? [no]: y

R1#
07:21:08: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/0 from FULL to DOWN, Neighbor
Down: Adjacency forced to reset

07:21:08: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/0 from FULL to DOWN, Neighbor
Down: Interface down or detached

07:21:08: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.10 on Serial0/0/1 from FULL to DOWN, Neighbor
Down: Adjacency forced to reset

07:21:08: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.10 on Serial0/0/1 from FULL to DOWN, Neighbor
Down: Interface down or detached

07:21:08: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.10 on Serial0/0/1 from LOADING to FULL,
Loading Done

07:21:08: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.10.9 on Serial0/0/0 from LOADING to FULL,
Loading Done

```

Task: Verify OSPF Operation

On the R1 router, Use the show ip ospf neighbor command to view the information about the OSPF neighbor routers R2 and R3.

```
R1#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.10.9	0	FULL/ -	00:00:35	192.168.10.2	Serial0/0/0
192.168.10.10	0	FULL/ -	00:00:31	192.168.10.6	Serial0/0/1

```
R1#
```

On the R1 router, use the show ip protocols command to view information about the routing protocol operation.

```

R1#show ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 14 seconds
Invalid after 180 seconds, hold down 180, flushed after 240
Outgoing update filter list for all interfaces is not set
Incoming update filter list for all interfaces is not set
Redistributing: rip
Default version control: send version 1, receive any version
  Interface          Send Recv Triggered RIP Key-chain
Automatic network summarization is in effect
Maximum path: 4
Routing for Networks:
  172.30.0.0
Passive Interface(s):
  FastEthernet0/0
Routing Information Sources:
  Gateway            Distance      Last Update
Distance: (default is 120)

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 10.4.4.4
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa

```

Task: Examine OSPF Routes in the Routing Tables

```

R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

  10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
S       10.10.10.0/24 [1/0] via 192.168.10.2
  172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
L       172.16.1.17/32 is directly connected, FastEthernet0/0
S       172.16.1.32/29 [1/0] via 192.168.10.6
  192.168.10.0/24 is variably subnetted, 5 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0
L       192.168.10.1/32 is directly connected, Serial0/0/0
C       192.168.10.4/30 is directly connected, Serial0/0/1
L       192.168.10.5/32 is directly connected, Serial0/0/1
--More-- |

```

Task: Configure OSPF Cost

Step 1: Use the show ip route command on the R1 router to view the OSPF cost to reach the 10.10.10.0/24 network.

```

R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

```

Gateway of last resort is not set

```

      10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
S       10.10.10.0/24 [1/0] via 192.168.10.2
      172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
L       172.16.1.17/32 is directly connected, FastEthernet0/0
S       172.16.1.32/29 [1/0] via 192.168.10.6
      192.168.10.0/24 is variably subnetted, 5 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0
L       192.168.10.1/32 is directly connected, Serial0/0/0
C       192.168.10.4/30 is directly connected, Serial0/0/1
L       192.168.10.5/32 is directly connected, Serial0/0/1

```

R1#|

Step 2: Use the show interfaces serial0/0/0 command on the R1 router to view the bandwidth of the Serial 0/0/0 interface.

```

R1#show interfaces serial0/0/0
Serial0/0/0 is up, line protocol is up (connected)
  Hardware is HD64570
  Internet address is 192.168.10.1/30
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
    Conversations 0/0/256 (active/max active/max total)
    Reserved Conversations 0/0 (allocated/max allocated)
    Available Bandwidth 1158 kilobits/sec
  5 minute input rate 58 bits/sec, 0 packets/sec
  5 minute output rate 55 bits/sec, 0 packets/sec
    38 packets input, 2700 bytes, 0 no buffer
    Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    36 packets output, 2816 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 output buffer failures, 0 output buffers swapped out

```

Step 3: Use the bandwidth command to change the bandwidth of the serial interfaces of

the R1 and R2 routers to the actual bandwidth, 64 kbps.

```
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface serial0/0/0
R1(config-if)#bandwidth 64
^
% Invalid input detected at '^' marker.

R1(config-if)#bandwidth 64
R1(config-if)#interface serial0/0/1
R1(config-if)#bandwidth 64
R1(config-if)#
```

```
R2>enable
Password:
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#interface serial0/0/0
R2(config-if)#bandwidth 64
R2(config-if)#interface serial0/0/1
R2(config-if)#bandwidth 64
R2(config-if)#
```

Step 4: Use the show ip ospf interface command on the R1 router to verify the cost of the serial links.

```
R1#show ip ospf interface

FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.17/28, Area 0
  Process ID 1, Router ID 10.4.4.4, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 10.4.4.4, Interface address 172.16.1.17
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:04
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.1/30, Area 0
  Process ID 1, Router ID 10.4.4.4, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:04
  Index 2/2, flood queue length 0
```

Step 5: Use the ip ospf cost command to configure the OSPF cost on the R3 router.


```

R3>enable
Password:
R3#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#interface serial0/0/0
R3(config-if)#ip ospf cost 1562
R3(config-if)#interface serial0/0/1
R3(config-if)#ip ospf cost 1562
R3(config-if)#|

```

Step 6: Use the show ip ospf interface command on the R3 router to verify that the cost of the link the cost of each of the Serial links is now 1562.

```

R3#show ip ospf interface

FastEthernet0/0 is up, line protocol is up
  Internet address is 172.16.1.33/29, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 10.3.3.3, Interface address 172.16.1.33
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:01
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.6/30, Area 0
  Process ID 1, Router ID 10.3.3.3, Network Type POINT-TO-POINT, Cost: 1562
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:01
  Index 2/2, flood queue length 0

```

Task: Redistribute an OSPF Default Route

Step 1: Configure a loopback address on the R1 router to simulate a link to an ISP.

```

R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#interface loopback1

R1(config-if)#
%LINK-3-UPDOWN: Interface Loopback1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback1, changed state to up

R1(config-if)#ip address 172.30.1.1 255.255.255.252
R1(config-if)#|

```


Step 2: Configure a static default route on the R1 router.

```
R1(config-if)#ip address 172.30.1.1 255.255.255.252
R1(config-if)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 loopback1
%Default route without gateway, if not a point-to-point interface, may impact performance
R1(config)#
```

Step 3: Use the default-information originate command to include the static route in the OSPF updates that are sent from the R1 router.

```
R1(config)#router ospf 1
R1(config-router)#default-information originate
R1(config-router)#
```

Step 4: View the routing table on the R2 router to verify that the static default route is being redistributed via OSPF.

```
R2>enable
Password:
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

    10.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C       10.2.2.2/32 is directly connected, Loopback0
C       10.10.10.0/24 is directly connected, FastEthernet0/0
L       10.10.10.1/32 is directly connected, FastEthernet0/0
    172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
S       172.16.1.16/28 [1/0] via 192.168.10.1
S       172.16.1.32/29 [1/0] via 192.168.10.10
    192.168.10.0/24 is variably subnetted, 5 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0
L       192.168.10.2/32 is directly connected, Serial0/0/0
O       192.168.10.4/30 [110/3124] via 192.168.10.10, 00:07:37, Serial0/0/1
        [110/3124] via 192.168.10.1, 00:07:37, Serial0/0/0
R2#
```

Task: Configure Additional OSPF Features

Step 1: Use the auto-cost reference-bandwidth command to adjust the reference bandwidth value.

```
R1(config-router)#auto-cost reference-bandwidth 10000
% OSPF: Reference bandwidth is changed.
   Please ensure reference bandwidth is consistent across all routers.
R1(config-router)#
```

```

R2(config-router)#auto-cost reference-bandwidth 10000
% OSPF: Reference bandwidth is changed.
    Please ensure reference bandwidth is consistent across all routers.
R2(config-router)#

R3(config-router)#auto-cost reference-bandwidth 10000
% OSPF: Reference bandwidth is changed.
    Please ensure reference bandwidth is consistent across all routers.
R3(config-router)#

```

Step 2: Examine the routing table on the R1 router to verify the change in the OSPF cost metric.

```

R1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

    10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C       10.1.1.1/32 is directly connected, Loopback0
S       10.10.10.0/24 [1/0] via 192.168.10.2
    172.16.0.0/16 is variably subnetted, 3 subnets, 3 masks
C       172.16.1.16/28 is directly connected, FastEthernet0/0
L       172.16.1.17/32 is directly connected, FastEthernet0/0
S       172.16.1.32/29 [1/0] via 192.168.10.6
    172.30.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.30.1.0/30 is directly connected, Loopback1
L       172.30.1.1/32 is directly connected, Loopback1
    192.168.10.0/24 is variably subnetted, 5 subnets, 2 masks
C       192.168.10.0/30 is directly connected, Serial0/0/0

```

Step 3: Use the show ip ospf neighbor command on R1 to view the Dead Time counter.

The Dead Time counter is counting down from the default interval of 40 seconds.

```

R1#show ip ospf neighbor

Neighbor ID      Pri   State           Dead Time   Address        Interface
10.3.3.3          0    FULL/ -         00:00:38   192.168.10.6   Serial0/0/1
10.2.2.2          0    FULL/ -         00:00:38   192.168.10.2   Serial0/0/0
R1#

```

Step 4: Configure the OSPF Hello and Dead intervals.

```

R1(config)#interface serial0/0/0
R1(config-if)#ip ospf hello-interval 5
R1(config-if)#ip ospf dead-interval 20
R1(config-if)#
R1(config-if)#
07:50:17: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from FULL to DOWN, Neighbor
Down: Dead timer expired

07:50:17: %OSPF-5-ADJCHG: Process 1, Nbr 10.2.2.2 on Serial0/0/0 from FULL to DOWN, Neighbor
Down: Interface down or detached

```

Step 5: Modify the Dead Timer and Hello Timer intervals.

```

R2(config-router)#interface serial0/0/0
R2(config-if)#ip ospf hello-interval 5
R2(config-if)#ip ospf dead-interval 20
R2(config-if)#
07:51:50: %OSPF-5-ADJCHG: Process 1, Nbr 10.4.4.4 on Serial0/0/0 from LOADING to FULL, Loading
Done

```

Step 5: Use the show ip ospf interface serial0/0/0 command to verify that the Hello Timer and Dead Timer intervals have been modified.

```

R2#show ip ospf interface serial0/0/0

Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.10.2/30, Area 0
  Process ID 1, Router ID 10.2.2.2, Network Type POINT-TO-POINT, Cost: 25178
  Transmit Delay is 1 sec, State POINT-TO-POINT,
  Timer intervals configured, Hello 5, Dead 20, Wait 20, Retransmit 5
    Hello due in 00:00:04
  Index 3/3, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 10.4.4.4
  Suppress hello for 0 neighbor(s)

```

Step 6: Use the show ip ospf neighbor command on R1 to verify that the neighbor adjacency with R2 has been restored.

```

R1#show ip ospf neighbor

Neighbor ID      Pri   State           Dead Time   Address        Interface
10.3.3.3          0    FULL/  -        00:00:39    192.168.10.6   Serial0/0/1
10.2.2.2          0    FULL/  -        00:00:19    192.168.10.2   Serial0/0/0
R1#

```

Task: Clean Up

Erase the configurations and disconnect attached cabling